State of California

Memorandum

To : Carl Yacoub, Supervising Water Control Engineer
Los Angeles Regional Board

Date : AUG 25 1987

From : Gil Torres, Senior Engineering Geologist, CEG 675
STATE WATER RESOURCES CONTROL BOARD

Subject: Subject: Lockheed California Company-Burbank Plants.

This pertains to the ongoing evaluation of subsurface pollutant occurrence in the vicinity of the Lockheed-California Company (CALAC) facilities within the City of Burbank.

As you requested in your May 5, 1987 memorandum to Bob Ford, I have reviewed the information presented by Gregg and Associates (GA) in the April 30, 1987 ground water monitoring program study for CALAC Plants A-1, B-1, B-6 and C-1. Understanding that similar ground water assessment work has not been performed in the vicinity of former CALAC Plant B-5, it is not known whether chemical pollutants have migrated from that locality to impair ground water quality in downgradient areas to the south and possibly to the southeast.

GENERAL COMMENTS

Because certain hydrogeologic factors remain unknown, it has been difficult to address the suitability of the existing monitoring well network in relation to the complementary "up to four additional wells" proposed by GA. Presented information suggests that ground water pollution sources may exist in areas other than those reported. Also, available basic data indicate that local subsurface geologic, hydrologic, and water quality parameters need to be better defined to meaningfully delineate the onsite vertical and horizontal extent of ground water pollution. This would be to ensure that a meaningful monitoring well program is instituted and to obtain detailed design criteria for construction of remedial measures that may be deemed technically appropriate.

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2. VOC occurrence in ground water at both Plant B-6 wells suggest that the pollution sources are located in areas where similar chemicals have been handled and/or stored. However, based on the existing data, it does not necessarily follow that the apparent VOC content increase at B-6-MW2 (relative to that at B-6-MW1) is due to leakage from any of the known storage tanks. Furthermore, it seems clear that polluted ground water has migrated to areas downgradient from B-6-MW2.

3. Ground water quality assessment work appears to be necessary at and/or near the other four Plant B-6 tank locations where soil contamination has been reported.

4. Assuming that the vertical distribution of VOCs in ground water at B-6-MW1 and -MW2 existed as reported prior to drilling and well construction, then it seems that the presence or absence of TCE and PCE at deeper depths (approximately below 400 feet) remains to be better defined in the vicinity of Plant B-6. In contrast, if it is assumed that the reported VOCs in ground water at deeper depths was caused by activities associated with well installation and/or ground water sampling, then the available water quality data would be questionable.

5. In the absence of definitive data on discrete hydraulic heads with depth, the respective geophysical and lithologic log information is such that the saturated zone portion above the 400-foot depth transmits ground water pollutants that can be at least partially attributed to handling and storage of chemicals in the area of Plant B-6. That saturated zone interval is primarily a water table or unconfined ground water body that is laterally correlative with that at or immediately above the 400-foot depth at wells C-1-MW1 and A-1-MW1, -MW3, and -MW4. Below that approximate depth, ground water-bearing coarse-grained units seem to be confined by clay interlayers in the vicinity of all of the monitoring well locations.

6. Although B-6 MW2 has been designated a "downgradient well of compliance", available ground water gradient information is too general to determine whether any other well within CALAC property is able to monitor polluted ground water that migrates from the Plant B-6 area.

7. Where clay layers separate the more permeable ground water bearing units, VOC concentration changes suggest that these lower permeability materials impede vertical movement of dissolved chemicals. However, because of the multiple screen and sand pack well design aspects, the impediment effectiveness by such clay

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In regard to the known nature and extent of subsurface geologic units, the concentration and vertical distribution of volatile organic compounds (VOCs) in ground water suggest that either downward hydraulic gradients have prevailed and/or that pollutant occurrence at deeper depths is attributable to the activities associated with the installation of monitoring wells. At this time, however, accurate determination of the causes for the vertical VOC distribution cannot be readily established due to the multiple-screen casing and continuous sand pack well design features at all monitoring locations. Furthermore, such features disallow for a definitive evaluation of preferential ground water flow direction within locally separate and laterally correlative coarse-grained materials or ground water-bearing zones. It is possible that historic subsurface hydrologic conditions may have caused polluted ground water movement within individually separate zones in directions other than to the reported south and southeast.

SPECIFIC COMMENTS

The geophysical logs, in combination with the lithologic logs, provide reasonably meaningful data for understanding the subsurface geologic factors that affect or partially govern the occurrence and movement of pollutants in ground water. On the basis of where such information has been obtained, it is readily apparent that an upper unconfined saturated zone exists within predominantly coarse-grained materials that were penetrated at each monitoring location west and northwest from well B-1-MW1. This geophysically and lithologically identifiable upper portion of the saturated zone constitutes a depth interval of about 150 feet at B-6-MW1 to approximately 200 feet at B-6-MW2 and at the wells in the vicinity of Plants A-1 and C-1. East of B-1-MWI, the saturated zone is primarily comprised of sand and clay interlayers that seem to be laterally continuous beneath Plant B-1. In that Plant B-1 area, the uppermost of the clay units approximates the top of the saturated zone. Also, based on the VOC concentration changes with depth, it appears that the clay units collectively have impeded the vertical migration of polluted ground water within the upper 200 feet of the saturated zone. Immediately below that saturated depth, ground water bearing materials are interlayered with significantly more prominent clay sequences as shown on all the geophysical logs except that for B-1-MW1. At B-1-MW1, significant ground water pollution has been reported at all of the sampled screen intervals.

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Commentary on other well-specific information is as follows:

Well C-1-MW1

1. Other than knowing that this well is hydraulically downgradient from Plant C-1, it is not clear which potential source of pollution, nor which portion of the pollution plume, is being monitored at this location. Assuming that the local direction of ground water flow has always been to the south-southeast from Plant C-1, then the low VOC concentrations seemingly have originated elsewhere off CALAC property. On the other hand, available data are insufficient to determine that this VOC pollution is not attributable to CALAC's activities. For this reason, it is apparent that additional subsurface evaluation work is necessary to determine the source, significance, and configuration of ground water pollution upgradient and further downgradient from Plant C-1. Development of such information is an integral part of gathering design criteria not only for meeting the objective of establishing an effective ground water monitoring program but also to formulate and implement remediation action measures as necessary.

2. The geophysical and lithologic logs obtained at this well location indicate that the top of the most significant clay interlayer sequence is at the 390-foot depth and predominates to the total drill hole depth of 550 feet. Even though trichloroethene (TCE) and perchloroethene (PCE) concentrations are relatively low above and below the 390-foot depth, it is apparent that clay layers can locally impede vertical movement of polluted ground water. Depending on a definitive evaluation of certain hydrogeologic factors, it then seems important to understand whether low concentration ground water pollution below the 390-foot depth is attributable to monitoring well design, corresponding drilling and well construction activities, and/or laterally upgradient onsite/offsite sources.

Wells B-6-MW1 and -MW2

1. In light of the southerly direction of ground water flow, available data on VOC occurrence at B-6-MW1 suggest that it is attributable to unknown upgradient onsite and/or offsite sources. This is in conformance with the apparently minimal amount of VOC leakage that has occurred at tank B-6-1. Yet, it is not clear whether the chemical-in-soil evaluation in this Plant B-6 area is complete to reasonably conclude that VOC presence at all B-6-MW1 screen intervals is solely attributable to laterally upgradient offsite sources.

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leakage at nearby tank A-1-B is not known and it is not clear that corresponding pollutant movement can be monitored at A-1-MW4.

3. Although PCE in ground water at A-1-MW3 may be partially attributable to leakage in the vicinity of sump A-1-ZH, it should be noted that PCE occurrence in A-1-MW1 ground water is also similarly significant. Assuming that the local ground water flow direction along all screened intervals is to the south, the available data would then suggest VOC movement from the vicinity of sump A-1-X to A-1-MW1. Therefore, it can be reasoned that more definitive subsurface work in this area is necessary to determine if CALAC-related chemical occurrence in possibly southerly-flowing ground water has been adequately discerned.

4. The basis for designating A-1-MW1 as a "downgradient well of compliance" is unclear. TCE and PCE content in ground water exceed Department of Health Services (DHS) action levels along the six screened intervals between the 153- to 502-foot depth range. Assuming that the direction of flow has always been south-southeasterly within each screened interval, then it is probable that such polluted ground water has migrated laterally beyond downgradient well A-1-MW4. This is in accordance with the reported 300 to 500 feet per year rate of ground water movement and the TCE and PCE concentrations found above the 380-foot depth at A-1-MW4.

5. Regardless of whether ground water pollution at A-1-MW1 is attributable solely to chemical movement from the Building 68 and 69 area, it appears that the subsurface distribution of VOCs needs delineation to the south and west. This is to further define the lateral and vertical extent of the plume, not only for the purpose of monitoring but also for developing definitive criteria to design remedial action measures that may be deemed necessary in this Plant A area.

6. Based on available information, it is not known whether ground water pollution at A-1-MW4 is solely attributable to the nearby and upgradient underground storage tanks A-1-F8, A1-F9, A 1-F12, A-1-N, A-1-U and A-1-V. Although A-1-N and local soils were reported to contain PCE, corresponding concentrations in A-1-MW4 ground water are significantly less than those found at the other two Plant A monitoring wells. Also, it should be noted that the reported petroleum hydrocarbons in local soils seem to have rendered the low toluene content along most of the saturated zone. The deeper toluene distribution may be partially due to the drilling, well installation, and/or sampling activities.

layers against polluted ground water movement remains to be better assessed. Nonetheless, the relatively thin clay layer(s) at about the 300-foot depth at both B-6-MW1 and -MW2 (as shown on the corresponding geophysical logs) seems to be at least a partial barrier to vertical pollutant movement at each well location. VOC concentration data at B-6-MW1 also suggest that the clay layers, at about a depth of 400-feet and deeper, impede the vertical movement of ground water that contains dissolved VOCs.

8. The more significant VOC concentrations in ground water are reported to be above the 400-foot depth at B-6-MW1. At B-6-MW2, significant VOC concentrations were detected above and below the 400-foot depth. Whether TCE and PCE concentrations below this depth are attributable to lateral migration of polluted ground water from an upgradient offsite area remains to be determined. If it is due to lateral migration, the data suggest that it is from an upgradient source other than where B-6-MW1 is located. Assuming that this deeper ground water pollution is not due to an onsite potential well conduit, then it seems doubtful that it is from an immediately upgradient pollution source or undefined area of soil contamination.

Wells A-1-MW1, -MW3 and -MW4

1. It is not known whether any portion of the ground water pollution that probably emanates from the Plant B-6 area, or possibly that from the Plant C-1 vicinity, can affect VOC occurrence at any of the three Plant A wells. Nevertheless, despite the known soil contamination areas that are reportedly upgradient from wells A-1-MW1 and -MW3, it is noteworthy that corresponding TCE and PCE concentrations in ground water to a depth of about 380 feet, approximate those within the upper 100 feet of the saturated zone at well B-6-MW2. However, even though "downgradient well of compliance " A-1-MW4 is similarly designed and constructed, TCE and PCE concentrations in that upper zone ground water (to a depth of about 380 feet) seem to be considerably less. Although these VOC concentration changes may be due to attenuation, it is not clear that A-1-MW4 is optimally located for monitoring purposes. The significance of continuing to monitor at the three Plant A wells seems to be dependent upon the gathering of more definitive data in the immediate vicinity.

2. According to the reported information, A-1-MW3 is located and constructed in a manner that may allow for monitoring chemicals associated with degreaser A-1-ZH. It is not known, however, whether chemicals in soil (from tank A 1-X ?) found beneath Building 68 and 69 can migrate to this monitoring well. Moreover, the spatial distribution and magnitude of chemical

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EPA Method 624) diminish considerably below 400 feet at A-1-MW3, those at corresponding well 14A depths seem to have remained essentially the same down to the 676- to 682-foot depth. The TCE and PCE concentrations were in excess of DHS action levels to as deep as the 812- to 818-foot deep sample.

2. The foregoing data, in conjunction with those obtained at A-1-MW4 and B-6-MW1, suggest that the entire vertical distribution of chemicals at well 14A is due primarily to its design and construction features in combination with previous municipal supply extractions. Available data also suggest that it is less reasonable that pollutants in ground water occur and move laterally within the deeper coarse-grained layers in areas upgradient from well 14A. Such lack of lateral movement assumes, however, that improperly abandoned wells do not exist within those upgradient areas where ground water pollution plumes are known to occur at lesser depth and that the deeper fine- and coarse-grained stratigraphic units are widespread beneath all CALAC property.

3. Based on the reported VOC concentrations at well 14A, it is reasonable to assume that this well has facilitated the lateral migration of polluted ground water preferentially through the more permeable coarse-grained units (such as those shown on the A-1-MW4 geophysical log) to downgradient areas.

4. Because the purpose of the 14A evaluation results was to optimize the depth and screen setting(s) of monitoring wells, it is not clear why more of those were not constructed to ascertain ground water pollution at depths greater than 500 feet.

5. Depending on the interval-specific upgradient and downgradient directions of ground water flow, it is likely that additional subsurface geologic, hydrologic, and water quality assessment work is necessary to define the vertical extent of CALAC-related pollution associated with this apparent well 14A conduit.

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CALAC Wells

1. In addition to locating existing and/or abandoned ground water and cathodic protection wells (see page 2 of January 24, 1986 proposal report by GA), driller's logs and associated construction details should be obtained for proper review. It is important to assess whether any of these wells can be a potential conduit that exacerbates the vertical movement of polluted ground water. Such information should assist in developing a comprehensive ground water monitoring well network.

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7. At A-1-MW4, TCE and PCE concentrations in ground water exceed DHS action levels above a depth of 380 feet and continued movement of these to downgradient areas remains to be evaluated. Therefore, its designation as "a downgradient well of compliance" seems questionable.

8. In reference to the reported TCE and PCE concentrations in ground water at A-1-MW3, the corresponding geophysical and lithologic logs indicate that clay layers, which exist within the 315- to 330-foot depth interval, seem to impede apparent downward movement of pollutants. The predominance of clay interlayers below the 400-foot depth also appear to be a collective impediment to apparent downward pollutant movement at that location. Whether the low TCE and PCE concentrations existed in ground water below the 400-foot depth prior to drilling and well installation cannot be ascertained on the basis of the available data.

9. In accordance with the geophysical and lithologic logs for A-1-MW1, it seems that the clay interlayer sequence below the 390-foot depth could be interpreted to locally retard vertical movement of pollutants. Although definitive data are unavailable, the occurrence of TCE and PCE below that depth could be attributable to induced ground water movement along the continuous sand pack during well development and/or sampling. However, assuming that TCE and PCE existed (prior to drilling) within the lowermost screened interval of 482 to 502 feet in depth, then it seems that evaluation and monitoring deeper ground water-bearing zones is necessary on the basis of the reported VOC concentrations.

10. At A-1-MW4, the significant TCE and PCE content in ground water decreases below the 380-foot depth appear to be attributable to the predominance of clay as indicated by the geophysical log curves. Even though corroborative data are unavailable, it seems that pollutant occurrence below that 380-foot depth may be due to the drilling, well installation and development/sampling activities.

City of Burbank Well 14A

1. In view of the stated purpose for evaluating chemical occurrence in ground water at municipal well 14A, the analytical results (as per the EPA Methods 601 and 602) indicate that significant VOC content was found between a depth range of 300 to more than 800 feet. The TCE and PCE concentrations from above the 400-foot depth seem to be somewhat similar to those obtained from apparently correlative stratigraphic units at "upgradient" well A-1-MW3. Although these VOC concentrations (determined by

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2. TCE and PCE concentrations suggest that the clay layers, primarily those at about the 200- and 300-foot depth intervals (as shown on the geophysical and lithologic logs), are locally partial impediments to vertical movement of polluted ground water. Also, the subsurface assessment work has been too limited to reasonably determine that the occurrence of polluted ground water at this well, especially at depths greater than 300 feet, is not from laterally upgradient sources.

3. Based on the VOC analysis results, the cause of ground water pollution at this well seems to be dissimilar to that which has affected ground water quality at upgradient well B-1-MW1.

Well B-1-MW3

1. In view of the TCE and PCE concentration changes in ground water, the clay layer between the 205- and 220-foot depth (see B-1-MW3 geophysical log) appears to locally impede the vertical movement of pollutants.

2. It is apparent that polluted ground water has migrated south - southeasterly from this "line of compliance well" at least within the sand unit immediately above the 205-foot depth. The corresponding lateral distribution of pollutants in ground water within the sand units below the 220-foot depth is unknown. Therefore, it seems appropriate that further subsurface assessment work be performed in both the upgradient and downgradient directions from B-1-MW3 to better assess local VOC occurrence in ground water.

Well B-1-MW4

1. Even though B-1-MW4 is reportedly located downgradient from sumps B-1-AM and B-1-J and a former waste disposal site, TCE and PCE concentrations appear to be detectable only in ground water sampled from the sand unit within the 150- to 182-foot depth interval. These VOC concentrations seem to be similar to those within this sand at wells B-1-MW7 (within an approximate 145- to 178-foot depth) and B-1-MW8 (within a depth range of about 145 to 172 feet).

2. The absence of TCE and PCE at the three well screen intervals beneath the 148- to 182-foot deep sand unit suggests that immediately underlying clay layers (shown on the B-1-MW4 geophysical log) retard downward movement of polluted ground water. In comparison, data obtained at wells B-1-MW7 and MW8 indicate low TCE and PCE content in ground water below that sand unit. This may reflect induced pollution related to the well

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2. Abandonment information should be obtained on wells previously used for CALAC ground water production purposes. Depending on various geologic and hydrologic factors, any improperly "plugged" well may be a potential conduit or pathway that facilitates movement of polluted ground water.

Plant B -5

Whether Plant B-5 is located hydraulically upgradient or downgradient from CALAC Plants A-1, B-1 and B-6, historic information regarding the handling and storage of VOCs at that formerly-operated plant should be obtained for proper review. It is not clear that possible Plant B-5-related ground water pollution does not affect that known to occur at wells to the south from the CALAC plants.

Well B-1-MW1

1. VOC concentrations in ground water at this well suggest that the probable pollution source is in the area of clarifier B-1-ZB. However, additional subsurface evaluative work in the immediate vicinity should be conducted to verify whether there are other upgradient sources that contribute to ground water pollution at B-1-MW1.

2. Although the B-1-MW1 geophysical and lithologic logs indicate that there is are least one prominent clay layer at 290 to 325 feet in depth, the vertical distribution of VOCs remained significant to as deep as the lowermost screened interval at 442 to 462 feet. It is not known, however, whether such vertical VOC distribution existed prior to drilling and well construction activities. This aspect should be properly evaluated. If it is found that the reported VOC distribution existed before drilling, then it would be appropriate to conduct subsurface work to depths deeper than the total 484 feet at B-1-MW1. This would be for the purpose of optimizing the design of any remedial measures that may be considered.

Well B-1-MW2

1. On the basis of the TCE and PCE concentrations in ground water and the reported south-southeasterly flow direction presumably within all of the screened intervals, the significance of the location of this well "along the downgradient line of compliance" is questionable. These data suggest that ground water pollution exists in the downgradient area from the CALAC property.

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3. The clay and/or clayey materials, shown on the B-1-MW7 geophysical log from about 180 to 225 feet in depth, seem to retard vertical migration of TCE and PCE at this well. Although there is a lack of definitive information on vertical hydraulic gradients, the evenly-distributed low VOC concentrations (coupled with the existence of significant clays interlayered with sand units) suggest chemical pollutant absence at depths deeper than 225 feet prior to the drilling and well construction activities.

4. It is apparent that PCE and TCE concentrations (in excess of DHS action levels) within the 145- to 175-foot deep sand extend laterally to the area downgradient from this "line of compliance" well.

Well B-1-MW8

1. Ground water within the sand unit at the approximate depth interval of 145 to 175 feet (see B-1-MW8 lithologic and geophysical logs) is reported to contain TCE and PCE concentrations in excess of the respective DHS action levels. Apparently, such pollution continues to migrate laterally through this ground water-bearing zone to the offsite downgradient area beyond the "line of compliance".

2. In view of the onsite potential pollution sources and the reported direction of ground water flow, it should be noted that TCE and PCE concentrations in ground water at this well approximate those at wells B-1-MW4 and -MW7.

3. To define a presumed eastern vertical and horizontal extent of the CALAC ground water pollution plume, it seems that additional assessment work is necessary in both the upgradient and downgradient directions from this well. Available data are insufficient to distinguish whether any onsite ground water pollution may be due to upgradient offsite sources.

CONCLUSIONS/INFORMATIONAL NEEDS

1. On the basis of the presented data, the stated objective of determining ground water quality beneath the CALAC facilities appears to have been only partially achieved. Additionally, the current or most recent installation of four monitoring wells (to complement the twelve that were initially installed) does not seem to be sufficient to distinguish and delineate ground water pollution associated with all the known potential sources located onsite from those that probably exist in offsite areas.

installation activities at those monitoring locations.

3. The significantly thick clay (from a depth of about 120 to 148 feet as shown on the B-1-MW4 geophysical log), which overlies the aforementioned sand unit, seems to have a permeability that is sufficiently low to preclude vertical movement of the minimal VOC concentrations within the uppermost and unconfined saturated sand unit. Similar clay, uppermost saturated sand, and corresponding low ground water pollutant concentrations appear to be laterally continuous to at least as far as wells B-1-MW7 and -MW8.

4. In light of the foregoing, it seems questionable that the nearby and upgradient sumps B-1-AM and B-1-J or the abandoned waste disposal facility are necessarily the source(s) of polluted ground water at this well. Thus, it appears appropriate to better evaluate potential sources in the area(s) further upgradient for the purpose of identifying others that may remain unknown. Also, it seems reasonable to locate and provide details concerning the type and extent of waste present at the former disposal facility.

5. TCE and PCE concentrations in excess of DHS action levels apparently continue to move from this well to offsite areas beyond the"downgradient line of compliance". For this reason, it is appropriate to delineate the configuration of ground water pollution in those downgradient areas for possible remedial action design purposes.

Well B-1-MW7

1. PCE content in ground water at B-1-MW7 suggests that possible leakage from an upgradient degreaser (B-1-ZR,-ZS or -ZT?) may be insignificant and/or that the site-specific PCE occurrence is due to migration from elsewhere. Also, it difficult to discern where the degreaser is exactly within Building 140B and whether there is PCE-polluted ground water in the immediate upgradient area from that location.

2. Based on the VOC concentration in ground water from the approximate 145- to 175-foot deep sand at B-1-MW7 (see geophysical log) and those from the corresponding 160- to 203-foot deep sand at B-1-MW3 (see geophysical log), it can be reasoned that the latter location is closer to a PCE leakage source.

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stratigraphic units at existing monitoring wells.

6. Assuming that the VOC concentrations in ground water existed at the reported screen depths prior to drilling and well installation, then the DHS action levels suggest that the subsurface pollution configuration merits further vertical and/or horizontal delineation at all of the CALAC plant facilities.

7. Based on the onsite TCE and PCE soil contamination data presented in regard to sumps A-1-X, A-1-ZH and clarifier B-1-ZB, corresponding VOC concentrations in ground water at nearby downgradient wells suggest that the pollution configuration attributable to those sources has not been properly delineated. The relative significance of the other reported TCE and PCE in soil concentrations must be known to better determine where additional ground water monitoring data should be obtained.

8. The significance of the entire ground water quality data base should be further reviewed in comparison with ensuing depth-specific samples to be obtained and analyzed for VOCs as per EPA Methods 601 and 602 (as indicated in the May 14, 1987 CALAC letter to the Regional Board). If possible, it would be opportune that those samples, or others that may be gathered during a subsequent round, be analyzed for magnesium content. Previous samples were analyzed for manganese concentrations that were inappropriately plotted on the Piper trilinear diagrams.

9. All future exploratory drill holes should be similarly geophysically-logged by Schlumberger as before to facilitate interpretation of the subsurface geologic features in relation to the hydrologic and water quality conditions in the vicinity of the CALAC property.

10. Assuming that the extent of soil contamination is reasonably well defined at all onsite areas and corresponding VOC plumes are adequately delineated, then the well B-1-MW1 area seems to merit early remediation consideration. Furthermore, according to the geophysical log obtained at this well location, the site-specific lesser amount of significant fine-grained low permeability layers has apparently facilitated the vertical spread of VOCs to below a depth of 460 feet. However, comparably significant VOC occurrence laterally from this location does not seem to have been found at reportedly downgradient well B-1-MW2 nor at any other well in the Plant B-1 area.

11. Assuming that any remediation plan to be developed for the well B-1-MW1 area includes a ground water extraction system, then the corresponding drawdown may hydraulically impact individual polluted ground water-bearing units to the southeast beneath

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2. In view of the single-well multiple screens and the continuous sand packs, it is technically desirable and appropriate to evaluate existing well design for the purpose of determining whether collected ground water quality data are reliable when monitoring for possible VOC content changes. At some localities, the multiple screens may readily provide for an admixture of ground water between or among saturated coarse-grained units especially when differing hydraulic heads prevail or if these are temporarily induced during extraction periods.

3. In spite of monitoring well design and the apparent absence of hydraulically confined aquifer zones, water quality results show that the vertical distribution of dissolved VOCs at monitoring wells is impeded by identifiable laterally-extensive low permeability fine-grained materials in localized areas such as that underlying most of Plant B-1 and those at deeper depths elsewhere. In contrast, the vertical distribution of these chemicals is facilitated within ground water pollution areas where previously-operated wells (such as City of Burbank Well 14A and possibly those within CALAC property) are located.

4. Assuming that the City of Burbank Well 14A ground water quality data are valid in regard to TCE and PCE occurrence, then it follows that this well should be properly abandoned as soon as possible to mitigate the apparent continued movement of pollutants from the relatively shallow to deeper ground water-bearing zones. Also, the horizontal and vertical extent of such pollution in that offsite area will likely necessitate appropriate study. Similar onsite evaluative work may be required to assess ground water pollution of deeper zones due to the presence of CALAC's previously-operated wells.

5. The possible lateral movement of polluted ground water to onsite areas (from those offsite) needs to be properly evaluated. It is not clear that the low level occurrence at reportedly upgradient wells B-6-MW1 and C-1-MW1 should be solely attributed to sources other than CALAC's. In addition to properly selecting sites sufficiently far from known CALAC pollution sources, effective evaluation of possible polluted ground water inflows should entail modifying target drilling depths in accordance with available site-specific subsurface data and improving well design aspects to preferentially monitor discrete coarse-grained zones. The latter should be such that "cross contamination" is avoided during all phases of well installation and subsequent development and ground water sampling activities. Also, the monitoring of discrete zones allows for obtaining information on possible potentiometric head differences with depth and the potential for movement or interchange of polluted ground water between or among